Modeling the Analytical Equations to Generate the Orbitsphere Current Vector Field

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Please consult the *Grand Unified Theory of Classical Physics* by Dr. Randell L. Mills. This file corresponds to the *Generation of the Orbitsphere CVFS* section of Chapter 1.

Initialization Cells

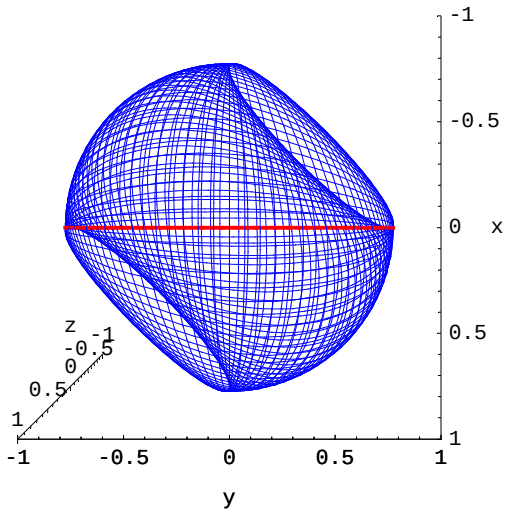
Generation of the Basis Element CVF

```
Clear[θ]
Equ84 = zrot[π/4].xrot[-θ].zrot[-π/4];
MatrixForm[%]
```

$$\begin{pmatrix} \frac{1}{2}+\frac{\cos[\theta]}{2} & -\frac{1}{2}+\frac{\cos[\theta]}{2} & -\frac{\sin[\theta]}{\sqrt{2}} \\ -\frac{1}{2}+\frac{\cos[\theta]}{2} & \frac{1}{2}+\frac{\cos[\theta]}{2} & -\frac{\sin[\theta]}{\sqrt{2}} \\ \frac{\sin[\theta]}{\sqrt{2}} & \frac{\sin[\theta]}{\sqrt{2}} & \cos[\theta] \end{pmatrix}$$

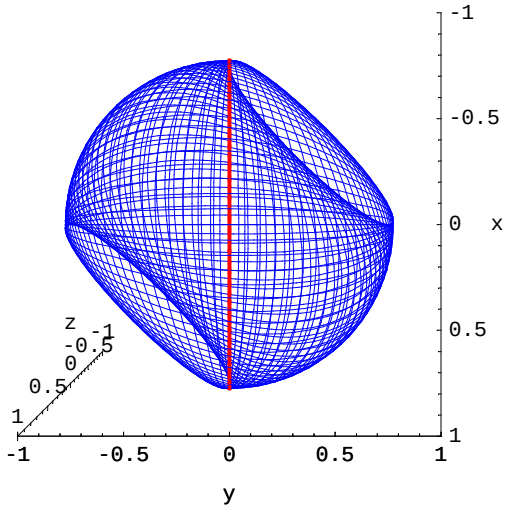
```
ComponentFunct[Equ84, {0, R Cos[ϕ], -R Sin[ϕ]}, {Red, Thickness[0.006]}, Blue];
```

```
Figure5 =
  Show[Array[p, 60], ViewPoint → {0, 0, 2}, Axes → True, AxesLabel → {x, y, z},
   ViewVertical → {-1, 0, 0}, DisplayFunction → $DisplayFunction];
```



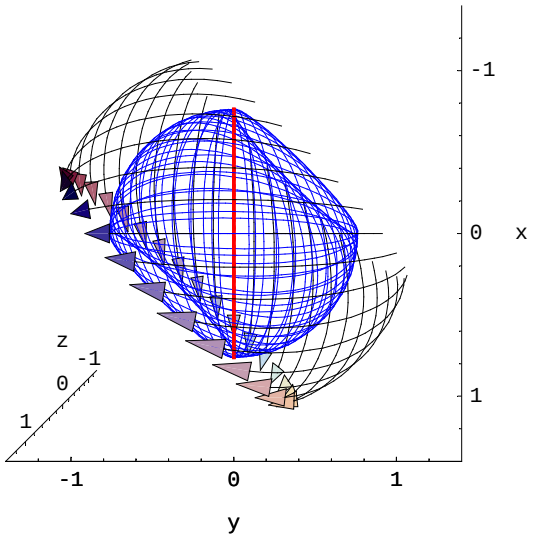

```
Clear[θ]
ComponentFunct[Equ84, {R Cos[ϕ], 0, -R Sin[ϕ]}, {Red, Thickness[0.006]}, Blue];
```

```
Figure6 =
  Show[Array[p, 60], ViewPoint → {0, 0, 2}, Axes → True, AxesLabel → {x, y, z},
   ViewVertical → {-1, 0, 0}, DisplayFunction → $DisplayFunction];
```




```
Clear[θ]
ArrowComponentFunct[Equ84, {R Cos[ϕ], 0, -R Sin[ϕ]},
  {0, 1 R, 1 R}, {0, -1 R, 1 R}, {Red, Thickness[0.006]}, Blue];
```

```
Figure7 = Show[Array[p, Steps],
   Array[arrows, Steps],
   ViewPoint → {0, 0, 2}, ViewVertical → {-1, 0, 0},
   Axes → True, AxesLabel → {x, y, z}, DisplayFunction → $DisplayFunction,
   PlotRange → {{-1.4, 1.4}, {-1.4, 1.4}, {-1.4, 1.4}}];
```



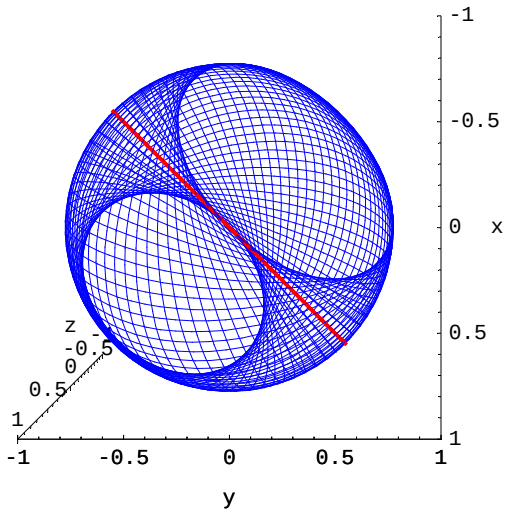
Generation of the Orbitsphere CVF

```
Clear[θ]
Equ95 = FullSimplify[zrot[π/4].yrot[π/4].zrot[θ].yrot[-π/4].zrot[-π/4]];
MatrixForm[%]
```

$$\begin{pmatrix} \frac{1}{4}(1+3\cos[\theta]) & \frac{1}{4}\left(-1+\cos[\theta]+2\sqrt{2}\sin[\theta]\right) & \frac{1}{4}\left(-\sqrt{2}+\sqrt{2}\cos[\theta]-2 \\ \frac{1}{4}\left(-1+\cos[\theta]-2\sqrt{2}\sin[\theta]\right) & \frac{1}{4}(1+3\cos[\theta]) & \frac{1}{4}\left(\sqrt{2}-\sqrt{2}\cos[\theta]-2\,S \\ \frac{1}{2}\left(\frac{-1+\cos[\theta]}{\sqrt{2}}+\sin[\theta]\right) & \frac{1}{4}\left(\sqrt{2}-\sqrt{2}\cos[\theta]+2\sin[\theta]\right) & \cos\left[\frac{\theta}{2}\right]^2 \end{pmatrix}$$

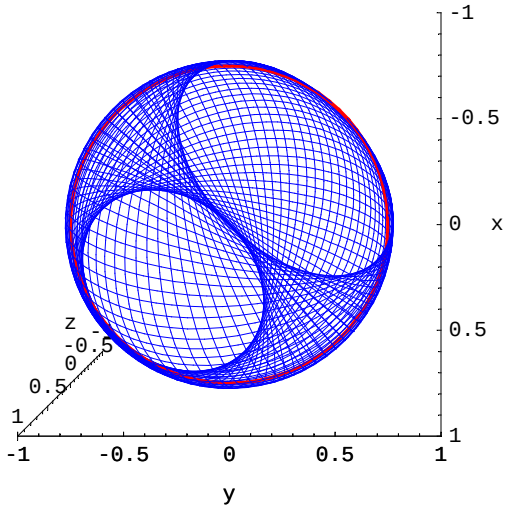
```
Clear[θ]
ComponentFunct[Equ95,
  {R/√2 Cos[ϕ], R/√2 Cos[ϕ], -R Sin[ϕ]}, {Red, Thickness[0.006]}, Blue];
```

```
Figure9 =
  Show[Array[p, 60], ViewPoint → {0, 0, 2}, Axes → True, AxesLabel → {x, y, z},
   ViewVertical → {-1, 0, 0}, DisplayFunction → $DisplayFunction];
```



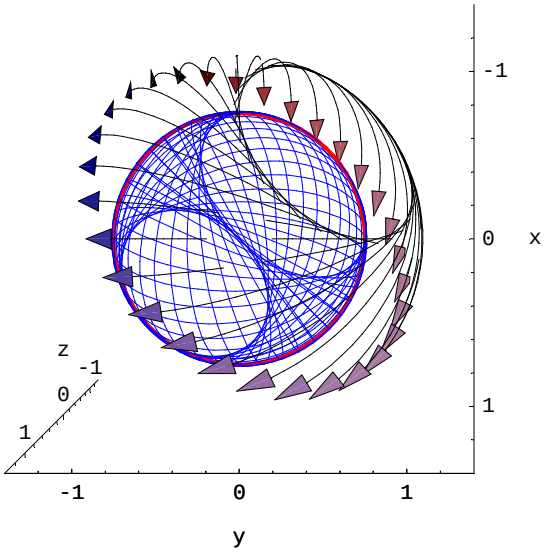

```
Clear[θ]
ComponentFunct[Equ95, {Cos[ϕ], Sin[ϕ], 0}, {Red, Thickness[0.006]}, Blue];
```

```
Figure10 =
  Show[Array[p, 60], ViewPoint → {0, 0, 2}, Axes → True, AxesLabel → {x, y, z},
   ViewVertical → {-1, 0, 0}, DisplayFunction → $DisplayFunction];
```




```
Clear[θ]
ArrowComponentFunct[Equ95, {Cos[ϕ], Sin[ϕ], 0},
  {0, 1 R, 1 R}, {0, -1 R, 1 R}, {Red, Thickness[0.006]}, Blue];
```

```
Figure11 = Show[Array[p, Steps],
   Array[arrows, Steps],
   ViewPoint → {0, 0, 2}, ViewVertical → {-1, 0, 0},
   Axes → True, AxesLabel → {x, y, z}, DisplayFunction → $DisplayFunction,
   PlotRange → {{-1.4, 1.4}, {-1.4, 1.4}, {-1.4, 1.4}}];
```



Generation of $Y_0^0(\phi, \theta)$

```
Clear[M]
θ := m 2π/M;
MatrixForm[Equ95]
```

$$\begin{pmatrix} \frac{1}{4}\left(1+3\cos\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(-1+\cos\left[\frac{2m\pi}{M}\right]+2\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(-\sqrt{2}+\sqrt{\right. \\ \frac{1}{4}\left(-1+\cos\left[\frac{2m\pi}{M}\right]-2\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(1+3\cos\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(\sqrt{2}-\sqrt{2}\right. \\ \frac{1}{2}\left(\frac{-1+\cos\left[\frac{2m\pi}{M}\right]}{\sqrt{2}}+\sin\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(\sqrt{2}-\sqrt{2}\cos\left[\frac{2m\pi}{M}\right]+2\sin\left[\frac{2m\pi}{M}\right]\right) & \end{pmatrix}$$

Change theta to gamma in Equ 84:

```
Clear[NN]
γ := -n 2π/NN;
Equ84B = {{1/2 + Cos[γ]/2, -1/2 + Cos[γ]/2, Sin[γ]/√2},
   {-1/2 + Cos[γ]/2, 1/2 + Cos[γ]/2, Sin[γ]/√2},
   {-Sin[γ]/√2, -Sin[γ]/√2, Cos[γ]}};
```

```
MatrixForm[%]
```

$$\begin{pmatrix} \frac{1}{2}+\frac{1}{2}\cos\left[\frac{2n\pi}{NN}\right] & -\frac{1}{2}+\frac{1}{2}\cos\left[\frac{2n\pi}{NN}\right] & -\frac{\sin\left[\frac{2n\pi}{NN}\right]}{\sqrt{2}} \\ -\frac{1}{2}+\frac{1}{2}\cos\left[\frac{2n\pi}{NN}\right] & \frac{1}{2}+\frac{1}{2}\cos\left[\frac{2n\pi}{NN}\right] & -\frac{\sin\left[\frac{2n\pi}{NN}\right]}{\sqrt{2}} \\ \frac{\sin\left[\frac{2n\pi}{NN}\right]}{\sqrt{2}} & \frac{\sin\left[\frac{2n\pi}{NN}\right]}{\sqrt{2}} & \cos\left[\frac{2n\pi}{NN}\right] \end{pmatrix}$$

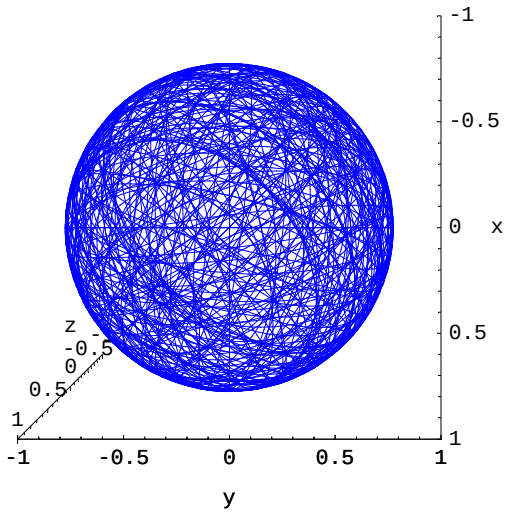
```
Equ103 = FullSimplify[Equ95.Equ84B]
MatrixForm[%]
```

$$\begin{pmatrix} \frac{1}{4}\left(1+\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\left(-1+\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]\right)-\sin\left[\frac{2n\pi}{NN}\right]+\cos\left[\frac{2m\pi}{M}\right]\left(1+2\cos\left[\frac{2n\pi}{NN}\right]+\sin\left[\frac{2n\pi}{NN}\right]\right)\right), \\ \frac{1}{4}\left(-1+\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\left(1+\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]\right)-\sin\left[\frac{2n\pi}{NN}\right]+\cos\left[\frac{2m\pi}{M}\right]\left(-1+2\cos\left[\frac{2n\pi}{NN}\right]+\sin\left[\frac{2n\pi}{NN}\right]\right)\right), \\ \frac{1}{4}\left(\cos\left[\frac{2n\pi}{NN}\right]\left(-\sqrt{2}+\sqrt{2}\cos\left[\frac{2m\pi}{M}\right]-2\sin\left[\frac{2m\pi}{M}\right]\right)-2\left(\sqrt{2}\cos\left[\frac{2m\pi}{M}\right]+\sin\left[\frac{2m\pi}{M}\right]\right)\sin\left[\frac{2n\pi}{NN}\right]\right)\}, \\ \{\frac{1}{4}\left(-1+\sin\left[\frac{2n\pi}{NN}\right]-\cos\left[\frac{2m\pi}{M}\right]\left(1-2\cos\left[\frac{2n\pi}{NN}\right]+\sin\left[\frac{2n\pi}{NN}\right]\right)-\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\left(1+\cos\left[\frac{2n\pi}{NN}\right]+\sin\left[\frac{2n\pi}{NN}\right]\right)\right), \\ \frac{1}{4}\left(1+\cos\left[\frac{2m\pi}{M}\right]\left(1+2\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]\right)+\sin\left[\frac{2n\pi}{NN}\right]-\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\left(-1+\cos\left[\frac{2n\pi}{NN}\right]+\sin\left[\frac{2n\pi}{NN}\right]\right)\right), \\ \frac{1}{4}\left(\cos\left[\frac{2n\pi}{NN}\right]\left(\sqrt{2}-\sqrt{2}\cos\left[\frac{2m\pi}{M}\right]-2\sin\left[\frac{2m\pi}{M}\right]\right)+2\left(-\sqrt{2}\cos\left[\frac{2m\pi}{M}\right]+\sin\left[\frac{2m\pi}{M}\right]\right)\sin\left[\frac{2n\pi}{NN}\right]\right)\}, \\ \{\frac{1}{2}\left(-\sqrt{2}\sin\left[\frac{m\pi}{M}\right]^2+\cos\left[\frac{2n\pi}{NN}\right]\sin\left[\frac{2m\pi}{M}\right]+\sqrt{2}\cos\left[\frac{m\pi}{M}\right]^2\sin\left[\frac{2n\pi}{NN}\right]\right), \\ \frac{1}{2}\left(\sqrt{2}\sin\left[\frac{m\pi}{M}\right]^2+\cos\left[\frac{2n\pi}{NN}\right]\sin\left[\frac{2m\pi}{M}\right]+\sqrt{2}\cos\left[\frac{m\pi}{M}\right]^2\sin\left[\frac{2n\pi}{NN}\right]\right), \\ \cos\left[\frac{m\pi}{M}\right]^2\cos\left[\frac{2n\pi}{NN}\right]-\frac{\sin\left[\frac{2m\pi}{M}\right]\sin\left[\frac{2n\pi}{NN}\right]}{\sqrt{2}}\}\} \end{pmatrix}$$

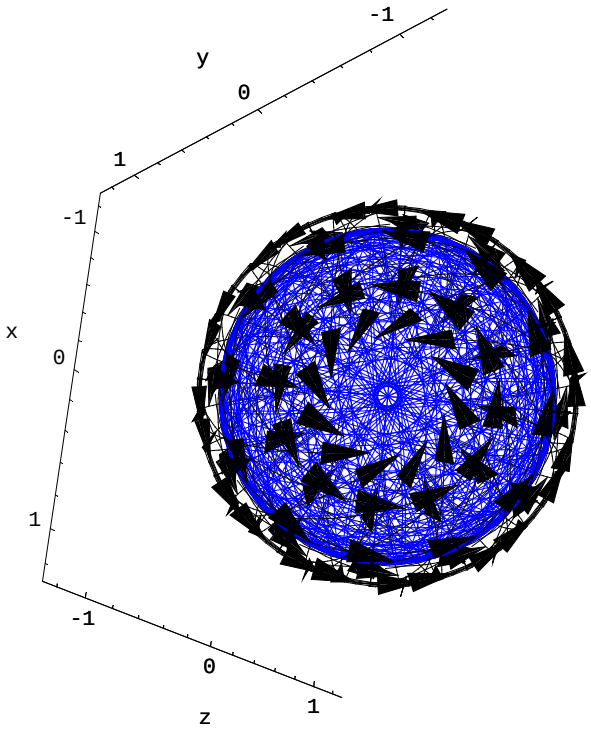
$$\begin{pmatrix} \frac{1}{4}\left(1+\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\left(-1+\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]\right)-\sin\left[\frac{2n\pi}{NN}\right]+\cos\left[\frac{2m\pi}{M}\right]\left(1+2\cos\left[\frac{2n\pi}{NN}\right]\right.\right. \\ \frac{1}{4}\left(-1+\sin\left[\frac{2n\pi}{NN}\right]-\cos\left[\frac{2m\pi}{M}\right]\left(1-2\cos\left[\frac{2n\pi}{NN}\right]+\sin\left[\frac{2n\pi}{NN}\right]\right)-\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\left(1+\cos\left[\frac{2n\pi}{NN}\right]\right.\right. \\ \left.\left.\frac{1}{2}\left(-\sqrt{2}\sin\left[\frac{m\pi}{M}\right]^2+\cos\left[\frac{2n\pi}{NN}\right]\sin\left[\frac{2m\pi}{M}\right]+\sqrt{2}\cos\left[\frac{m\pi}{M}\right]^2\sin\left[\frac{2n\pi}{NN}\right]\right)\right. \end{pmatrix}$$

```
Clear[M, NN]
ConvolutionFunct[Equ103, {0, R Cos[ϕ], -R Sin[ϕ]}, {Blue}, Blue];
```

```
Figure12 = Show[Array[Component, {Sets}], ViewPoint → {0, 0, 2},
   ViewVertical → {-1, 0, 0}, Axes → True, AxesLabel → {x, y, z},
   PlotRange → {{-1, 1}, {-1, 1}, {-1, 1}}, DisplayFunction → $DisplayFunction];
```



```
ArrowConvolutionFunctClock[Equ103,
  {0, R Cos[ϕ], R Sin[ϕ]}, {0, .8 R, .8 R}, {0, -.8 R, .8 R}, Blue, Blue];
Figure11Arrows = Show[Array[Component, {12}]];
Figure13 = Show[Figure12, Figure11Arrows,
   ViewPoint → {-(-1/√2) 2, -(1/√2) 2, -(1) 2}, Axes → True,
   AxesLabel → {x, y, z}, PlotRange → {{-1.3, 1.3}, {-1.3, 1.3}, {-1.3, 1.3}},
   DisplayFunction → $DisplayFunction, Lighting → False];
```

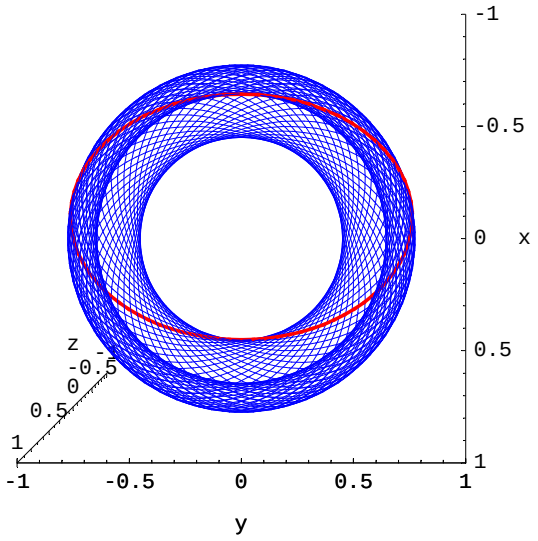



```
Clear[θ]
Equ104 = zrot[θ].yrot[-π/4];
MatrixForm[%]
```

$$\begin{pmatrix} \frac{\text{Cos}[\theta]}{\sqrt{2}} & \text{Sin}[\theta] & \frac{\text{Cos}[\theta]}{\sqrt{2}} \\ -\frac{\text{Sin}[\theta]}{\sqrt{2}} & \text{Cos}[\theta] & -\frac{\text{Sin}[\theta]}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \end{pmatrix}$$

```
ComponentFunct[Equ104, {R Cos[ϕ], R Sin[ϕ], 0}, {Red, Thickness[0.006]}, Blue];
```

```
Figure14 =
  Show[Array[p, 60], ViewPoint → {0, 0, 2}, Axes → True, AxesLabel → {x, y, z},
   ViewVertical → {-1, 0, 0}, DisplayFunction → $DisplayFunction];
```

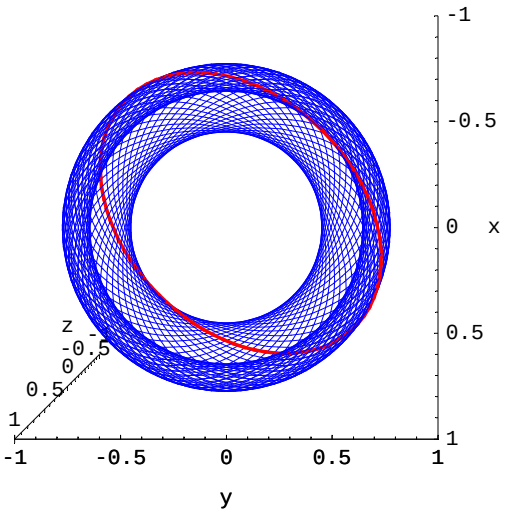



```
Clear[θ]
Equ106 = FullSimplify[zrot[π/4].zrot[θ].yrot[-π/4]];
MatrixForm[%]
```

$$\begin{pmatrix} \frac{1}{2}(\text{Cos}[\theta]-\text{Sin}[\theta]) & \frac{\text{Cos}[\theta]+\text{Sin}[\theta]}{\sqrt{2}} & \frac{1}{2}(\text{Cos}[\theta]-\text{Sin}[\theta]) \\ \frac{1}{2}(-\text{Cos}[\theta]-\text{Sin}[\theta]) & \frac{\text{Cos}[\theta]-\text{Sin}[\theta]}{\sqrt{2}} & \frac{1}{2}(-\text{Cos}[\theta]-\text{Sin}[\theta]) \\ -\frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \end{pmatrix}$$

```
ComponentFunct[Equ106, {R Cos[ϕ], R Sin[ϕ], 0}, {Red, Thickness[0.006]}, Blue];
```

```
Figure15 =
  Show[Array[p, 60], ViewPoint → {0, 0, 2}, Axes → True, AxesLabel → {x, y, z},
   ViewVertical → {-1, 0, 0}, DisplayFunction → $DisplayFunction];
```




```
Clear[M]
θ := m 2π/M;
MatrixForm[Equ95]
```

$$\begin{pmatrix} \frac{1}{4}\left(1+3\cos\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(-1+\cos\left[\frac{2m\pi}{M}\right]+2\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(-\sqrt{2}+\sqrt{ \\ \frac{1}{4}\left(-1+\cos\left[\frac{2m\pi}{M}\right]-2\sqrt{2}\sin\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(1+3\cos\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(\sqrt{2}-\sqrt{2} \\ \frac{1}{2}\left(\frac{-1+\cos\left[\frac{2m\pi}{M}\right]}{\sqrt{2}}+\sin\left[\frac{2m\pi}{M}\right]\right) & \frac{1}{4}\left(\sqrt{2}-\sqrt{2}\cos\left[\frac{2m\pi}{M}\right]+2\sin\left[\frac{2m\pi}{M}\right]\right) & \end{pmatrix}$$

Change theta to gamma in Equ 106:

```
Clear[NN]
γ := n 2π/NN;
```

$$\text{Equ106B} = \begin{pmatrix} \frac{1}{2}(\cos[\gamma]-\sin[\gamma]) & \frac{\cos[\gamma]+\sin[\gamma]}{\sqrt{2}} & \frac{1}{2}(\cos[\gamma]-\sin[\gamma]) \\ \frac{1}{2}(-\cos[\gamma]-\sin[\gamma]) & \frac{\cos[\gamma]-\sin[\gamma]}{\sqrt{2}} & \frac{1}{2}(-\cos[\gamma]-\sin[\gamma]) \\ -\frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \end{pmatrix};$$

```
MatrixForm[%]
```

$$\begin{pmatrix} \frac{1}{2}\left(\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]\right) & \frac{\cos\left[\frac{2n\pi}{NN}\right]+\sin\left[\frac{2n\pi}{NN}\right]}{\sqrt{2}} & \frac{1}{2}\left(\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]\right) \\ \frac{1}{2}\left(-\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]\right) & \frac{\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]}{\sqrt{2}} & \frac{1}{2}\left(-\cos\left[\frac{2n\pi}{NN}\right]-\sin\left[\frac{2n\pi}{NN}\right]\right) \\ -\frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \end{pmatrix}$$

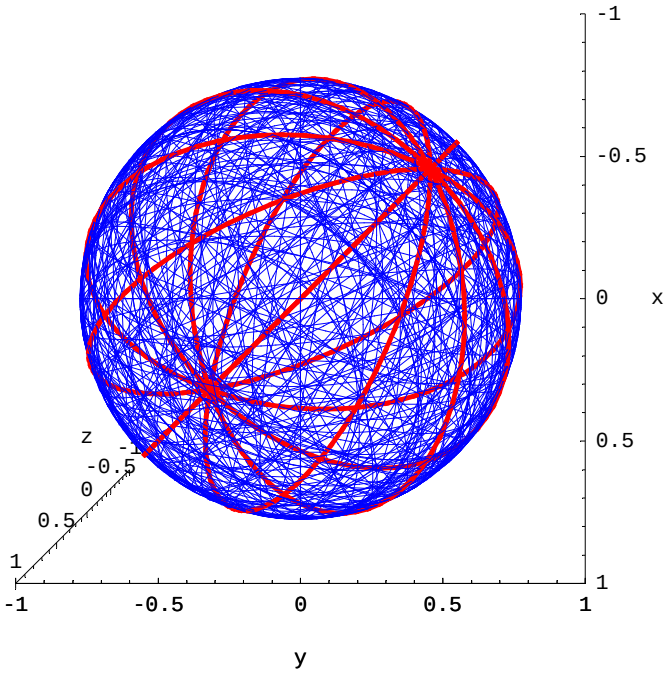
Equ109 = FullSimplify[Equ95.Equ106B]
MatrixForm[%]

$$\left\{\left\{\frac{1}{4}\left(1+\text{Cos}\left[\frac{2n\pi}{NN}\right]+\text{Cos}\left[\frac{2m\pi}{M}\right]\left(-1+\text{Cos}\left[\frac{2n\pi}{NN}\right]-2\,\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)-\right.\right.$$
$$\left.\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\left(-1+\text{Cos}\left[\frac{2n\pi}{NN}\right]+\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)\right),$$
$$\frac{\text{Cos}\left[\frac{2n\pi}{NN}\right]\left(2\,\text{Cos}\left[\frac{2m\pi}{M}\right]+\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\right)+\left(1+\text{Cos}\left[\frac{2m\pi}{M}\right]-\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\right)\text{Sin}\left[\frac{2n\pi}{NN}\right]}{2\sqrt{2}},$$
$$\frac{1}{4}\left(-1+\text{Cos}\left[\frac{2n\pi}{NN}\right]+\text{Cos}\left[\frac{2m\pi}{M}\right]\left(1+\text{Cos}\left[\frac{2n\pi}{NN}\right]-2\,\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)-\right.$$
$$\left.\left.\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\left(1+\text{Cos}\left[\frac{2n\pi}{NN}\right]+\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)\right)\right\},$$
$$\left\{\frac{1}{4}\left(-2\,\text{Cos}\left[\frac{n\pi}{NN}\right]^2+\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\left(1-\text{Cos}\left[\frac{2n\pi}{NN}\right]+\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)-\right.\right.$$
$$\left.\text{Cos}\left[\frac{2m\pi}{M}\right]\left(-1+\text{Cos}\left[\frac{2n\pi}{NN}\right]+2\,\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)\right),$$
$$\frac{\text{Cos}\left[\frac{2n\pi}{NN}\right]\left(2\,\text{Cos}\left[\frac{2m\pi}{M}\right]-\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\right)-\left(1+\text{Cos}\left[\frac{2m\pi}{M}\right]+\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\right)\text{Sin}\left[\frac{2n\pi}{NN}\right]}{2\sqrt{2}},$$
$$\frac{1}{4}\left(2\,\text{Sin}\left[\frac{n\pi}{NN}\right]^2+\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\left(-1-\text{Cos}\left[\frac{2n\pi}{NN}\right]+\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)-\right.$$
$$\left.\left.\text{Cos}\left[\frac{2m\pi}{M}\right]\left(1+\text{Cos}\left[\frac{2n\pi}{NN}\right]+2\,\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)\right)\right\},$$
$$\left\{\frac{1}{2}\left(-\sqrt{2}\,\text{Cos}\left[\frac{m\pi}{M}\right]^2-\sqrt{2}\,\text{Cos}\left[\frac{2n\pi}{NN}\right]\text{Sin}\left[\frac{m\pi}{M}\right]^2-\text{Sin}\left[\frac{2m\pi}{M}\right]\text{Sin}\left[\frac{2n\pi}{NN}\right]\right),\right.$$
$$\frac{\text{Cos}\left[\frac{2n\pi}{NN}\right]\text{Sin}\left[\frac{2m\pi}{M}\right]}{\sqrt{2}}-\text{Sin}\left[\frac{m\pi}{M}\right]^2\text{Sin}\left[\frac{2n\pi}{NN}\right],$$
$$\left.\left.\frac{1}{2}\left(\sqrt{2}\,\text{Cos}\left[\frac{m\pi}{M}\right]^2-\sqrt{2}\,\text{Cos}\left[\frac{2n\pi}{NN}\right]\text{Sin}\left[\frac{m\pi}{M}\right]^2-\text{Sin}\left[\frac{2m\pi}{M}\right]\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)\right\}\right\}$$

$$\begin{pmatrix}\frac{1}{4}\left(1+\text{Cos}\left[\frac{2n\pi}{NN}\right]+\text{Cos}\left[\frac{2m\pi}{M}\right]\left(-1+\text{Cos}\left[\frac{2n\pi}{NN}\right]-2\,\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)-\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\left(-1+\text{Cos}\left[\frac{2n}{NN}\right]\right.\right. \\ \frac{1}{4}\left(-2\,\text{Cos}\left[\frac{n\pi}{NN}\right]^2+\sqrt{2}\,\text{Sin}\left[\frac{2m\pi}{M}\right]\left(1-\text{Cos}\left[\frac{2n\pi}{NN}\right]+\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)-\text{Cos}\left[\frac{2m\pi}{M}\right]\left(-1+\text{Cos}\left[\frac{2n\pi}{NN}\right]\right. \\ \frac{1}{2}\left(-\sqrt{2}\,\text{Cos}\left[\frac{m\pi}{M}\right]^2-\sqrt{2}\,\text{Cos}\left[\frac{2n\pi}{NN}\right]\text{Sin}\left[\frac{m\pi}{M}\right]^2-\text{Sin}\left[\frac{2m\pi}{M}\right]\text{Sin}\left[\frac{2n\pi}{NN}\right]\right)\end{pmatrix}$$

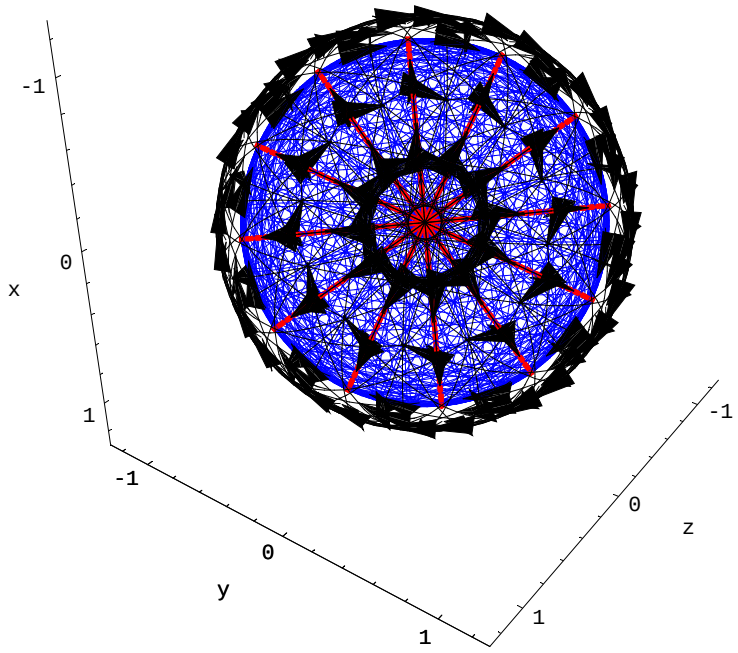
ConvolutionFunct[Equ109, {R Cos[ϕ], R Sin[ϕ], 0}, {Red, Thickness[0.006]}, Blue];

```
Figure16 = Show[Array[Component, {12}], Axes → True,
   AxesLabel → {x, y, z}, ViewPoint → {0, 0, 2}, ViewVertical → {-1, 0, 0},
   PlotRange → {{-1, 1}, {-1, 1}, {-1, 1}}, DisplayFunction → $DisplayFunction];
```



```
ArrowConvolutionFunctClock[Equ109, {R Cos[ϕ], R Sin[ϕ], 0},
  {0, .8 R, .8 R}, {0, -.8 R, .8 R}, {Red, Thickness[0.006]}, Blue];

Figure17 = Show[Figure16, Array[Component, {12}],
   ViewPoint → {-1/Sqrt[2] 2, 1/Sqrt[2] 2, (1) 2}, Axes → True, AxesLabel → {x, y, z},
   PlotRange → {{-1.3, 1.3}, {-1.3, 1.3}, {-1.3, 1.3}}, ViewVertical → {-1, 0, 0},
   DisplayFunction → $DisplayFunction, Lighting → False];
```




```
Figure17Arrows = Show[Array[Component, {12}],
   ViewPoint → {-1/Sqrt[2] 2, 1/Sqrt[2] 2, (1) 2}, Axes → True,
   AxesLabel → {x, y, z}, PlotRange → {{-1.3, 1.3}, {-1.3, 1.3}, {-1.3, 1.3}},
   ViewVertical → {-1, 0, 0}, DisplayFunction → Identity, Lighting → False];

SolidSphere = Show[Graphics3D[{GrayLevel[0.5], EdgeForm[], Sphere[.9]}],
   Lighting → False, DisplayFunction → Identity];
```

```
Figure22 = Show[SolidSphere, Figure17Arrows, DisplayFunction → $DisplayFunction,
    ViewPoint → {-(1/√2) 2, (1/√2) 2, (1) 2}, Boxed → False];
```